

CHAPTER 15

MAINTENANCE SCHEDULES

15-1. Personnel.

This chapter sets up timetables for maintenance actions. Whenever the electrical shop/electrician or the electrical supervisor is mentioned, it refers to the appropriate shop or individual responsible to the facilities engineer, the public works officer, the base civil engineer or to the appropriate individual having responsibility for the maintenance of real property facilities. The user or using service is the occupant actually benefiting from the service. The maintenance group consists of personnel who are responsible for the routine scheduled maintenance of real property facilities. This group may or may not have affiliated electrical personnel. The operator has the responsibility for starting, operating and securing the equipment when not in use.

15-2. Responsibilities.

The responsibility for maintenance of all real property electrical items will be assigned to the electrical shop/electrician. For example, the electrical shop/electrician is responsible for electric motors and pertinent controls that power such equipment as air conditioners, boilers and water pipes, even though the overall responsibility for the powered equipment is assigned to other shops. While most of the electrical maintenance will be accomplished by personnel in the electrical shop/electrician, it is often more logical and economical to have certain tasks, particularly preventive maintenance, accomplished by other personnel. Such tasks will be determined by the electrical supervisor who, through coordination and inspection, assures adequacy of the work performed. Often the user or other shops have the capability to perform periodic electrical maintenance. For example, air conditioning mechanics generally have the capability to service motors and controls associated with their responsibilities. In designating tasks for others, the electrical supervisor will be guided by their capabilities. In tables 15-3 and 15-4 entries in the column headed "responsibility" indicate the suggested groups that might be expected to perform the listed maintenance work at typical military installations. These suggested assignments may be changed to suit local conditions and capabilities.

15-3. Frequencies and procedures.

Of many factors involved in reliability of equipment, timely and high quality preventive maintenance

are very important. A properly developed and implemented electrical preventive maintenance program minimizes equipment failure. However, performing maintenance at too frequent intervals is expensive, both in labor and material costs, but sometimes this can also cause failure. Thus there is a general optimum interval between scheduled preventive maintenance instances. Table 15-1 lists the data regarding percentage of failures since last maintenance. From this table, the following conclusions regarding maintenance frequency can be drawn.

a. One year or less interval for scheduled maintenance of all electrical equipment combined as a general rule is desirable.

b. One year interval for circuit breaker is appropriate.

c. Two year interval for motors (DC motors may need more frequent maintenance compared to AC motors) should be sufficient (bearings may need more attention).

d. Two year interval for transformers.

e. This interval needs to be adjusted for specific equipment, type of duty, operating environment and quality of maintenance. Quality of maintenance can be factored into the failure rate by using multipliers shown in table 15-2. For example, poor quality of motor maintenance will double (1.97 in table 15-2) its failure rate for the same maintenance interval, whereas perfect maintenance reduces the failure rate (given in table 15-4) by 16 percent. The preventive maintenance inspection and service frequencies that follow (tables 15-3 and 15-4) are guides which may be modified to meet local requirements. Whenever manpower constraints prevent the facilities manager in following the suggested maintenance frequency, procuring outside contractors is an option. However, if budgetary constraints make this an impossible task, then maintenance should be scheduled as close to the suggested interval as possible. Exceptions should not be made for maintaining equipment and facilities which serve critical loads and functions. The maintenance group or user should immediately report any defects beyond their repair capability to the electrical shop/electrician. They should keep records of all defects in the system and corrective actions taken to repair these defects. The table inputs are self-explanatory. The references are to sections in this manual covering procedures of inspections and maintenance.

Table 15-1. Percentage of failure caused since maintained.

Failure (months since maintained)	All Electrical Equipment Classes Combined	Circuit Breakers	Motors Wire	Open	Transformers
Less Than 12 months ago	7.4%	*12.5%	8.8%	*0	*2.9%
12-24 months ago	11.2%	19.2%	8.8%	*22.2%	2.6%
More than 24 months ago	36.7%	77.8%	44.4%	38.2%	36.4%
Total	16.4%	20.8%	15.8%	30.6%	11.1%

*small sample size; less than 7 failures caused by inadequate maintenance.

Table 15-2. Equipment failure rate multipliers versus maintenance quality.

Maintenance Quality	Transformers	Circuit Breakers	Motors
Excellent	0.95	0.91	0.89
Fair	1.05	1.06	1.07
Poor	1.51	1.28	1.97
All	1.00	1.00	1.00
Perfect Maintenance	0.89	0.79	0.84

Tables 15-1 and 15-2 reproduced here from ANSI/IEEE Std 493-1980, IEEE Recommended Practice for Design of Reliable Industrial and Commercial Power Systems, copyright C 1985 by The Institute of Electrical and Electronics Engineers, Inc., with permission of the IEEE Standards Department.

Note: The Navy will follow inspection and service frequencies as established in this section. Modifications will be made as required by NAVFAC MO-322,

Inspection for Maintenance Public Works and Public Utilities, and Volume 2, Inspection Guides-Electrical.

Table 15-3. Interior wiring and lighting system.

RESPONSIBILITY	FREQUENCY	CHECK	REF.
Maintenance Group (Operator/ Electricians)	Each scheduled building visit	<p>Unauthorized or nonstandard attachments</p> <p>Defective convenience outlets and switches.</p> <p>Improper cords.</p> <p>Proper fuse sizes in panels.</p> <p>Overheating of panels.</p> <p>Any condition likely to cause fire. Check battery-type emergency lights and replacement lamps. Check for lamps larger than standard prescribed for outlet.</p> <p>Replace burnt out lamps in hard-to-reach places. (To be accomplished by electrical shop if special equipment such as ladder trucks are needed).</p>	<p>5-4-4</p> <p>9-7</p> <p>9-6</p>
User	As Required	<p>Panels for circuit identification and accessibility.</p> <p>Replace blown fuses.</p> <p>Replace burnt out or defective incandescent lamps.</p> <p>Replace burnt out fluorescent lamps if personnel have been instructed in this function and if assigned to user. Promptly replace or report defective lamps since a lamp approaching burn out flashes on and off, causing overduy on auxiliary equipment.</p>	<p>5-4-1</p> <p>5-4-4</p> <p>9-6</p> <p>9-6</p>
Electrician	As required.	Make repairs and adjustments to systems when malfunctions are reported. Ensure that all work complies with the NEC	
Electrician	As required.	<p>Check ground resistance for special weapons facilities at request of user.</p> <p>Check for low voltages and/or low power factor.</p>	<p>14-5</p> <p>13-2</p>
Electrician	Monthly or Annually	<p>Inspect station (substation switchgear or UPS) as follows:</p> <p>(1) Check electrolyte level and add distilled water if needed.</p> <p>(2) Check charging rate. Adjust charging rate as necessary to maintain proper specific gravity.</p> <p>(3) Test for proper operation under simulated power interruption. Check maintenance free batteries. Check voltage, check and clean terminal/connection.</p>	2-8-3

Table 15-3. Interior wiring and lighting system-continued.

RESPONSIBILITY	FREQUENCY	CHECK	REF.
Electrician	As required	<p>Infrared scan, if available, and inspect buildings for defective wiring and loose connections. Tighten or replace, as necessary. Check grounds for continuity. Check all systems for abnormal conditions. Correct discrepancies.</p> <p>Inspect disconnects, cabinets, panels and load centers. Tighten connections. Clean panels. Check fuse sizes. Manually operate switches and breakers.</p> <p>Use ohmmeter to detect grounds. Eliminate defects.</p> <p>Check and correct unbalance of loads</p> <p>Clean transformers, ducts and capacitors.</p>	<p>14-4</p> <p>chapter 5</p> <p>13-2</p> <p>chapter 3, 24, 2-8-2.</p>
Electrician	As required	Clean lighting fixtures whenever foot-candle readings drop 20 to 25%. This will beat approximately annual intervals in ordinary offices, longer in clean rooms, and at lesser intervals for dirty areas. Work should be accomplished by custodial or by user if within capabilities.	9-5
Electrician	Every Year	<p>Test power circuit breakers and protective relays</p> <p>Test metering and indicating instruments</p>	<p>2-8-8</p> <p>2-8-4, 2-8-5, 2-8-7</p>
Electrical Shop	Every 5 years	<p>Test molded case feeder and main circuit breakers in main panelboards.</p> <p>Test single phase watt hour meters.</p>	<p>5 4 3</p> <p>2-8-5</p>

Table 15-4. Electric motors and controls.

RESPONSIBILITY	FREQUENCY	CHECK	REF.
Maintenance group	As Required	Report any unusual conditions. Clean and lubricate those motors assigned to the team for this purpose	
User	As Required	Keep area around motors free from obstructions. Report any: (1) Unusual noises (2) Overheating (3) Accumulation of dust and moisture (4) Sparking (5) Difficulty in coming up to speed	4-4
Operator	Weekly	Check oil level on sleeve bearing motors with oil gages. Fill, if necessary. Add oil and check only when motor is stopped. Check belts for suitable slack.. Adjust as necessary.	4-2-5-2-2
Electrician	As required	Check brushes in holders for fit and free play. Tighten brush studs. Replace brushes if necessary. Inspect commutator for high mica. glaze, roughness or scratches. Check for vibration. Check shunt, series, and commutating fields or tightness. Check cable connections. Check for bearing wear. Lubricate ball bearings.	4-342 4-343 444 4-3 4-2-s-2-1
Electrician	Annually	Measure insulation resistance on motors over 10 hp. Check winding insulation for cracks or other defects. Make sure windings are dry.	4-2-5-3
Electrician	Annually	Check air gap between rotor and stator on motors over 1 horsepower. Use long feeler gages for this purpose. A record of yearly checks will give a picture of bearing wear. A variation of 10 percent from one year to the next is permissible.	4-2-5-1
Operator	Quarterly	Check belts to insure that they are no tighter than necessary to insure against slipping. Check chains for evidence of wear.	4-4-3
Operator	Annually	Maintain proper alignment between motor and machine that it drives. Check motor to see that end thrust is not excessive and shaft has a reasonable axial float. Lubricate motors. Flush and refill oil reservoirs. Use lubricants recommended by equipment manufacture. Frequency of lubrication depends on usage of motors. Grease lubricated ball or roller bearing motors may require lubrication only once a year if motor is operated lightly, but as often as every 2 months if hard driven. Do not mix greases of different type or specifications.	4-4-4 4-4-4 4-2-5-2

Table 15-4. Electric motors and controls-continued.

RESPONSIBILITY	FREQUENCY	CHECK	REF.
Electrical Shop	Annually	Inspect brushes and holders. Adjust spring tension. Do not attempt to correct uneven feed by bending springs. Replace springs if necessary. Brushes normally last for approximately 2,500 hours. Maintain spare brushes for quick availability to electric shop at all hours.	4-3-4-2
Electrician	Annually	<p>Inspect commutator. Sand with No. 00 sandpaper, grind or turn down commutator as necessary to eliminate grooving. DO NOT use emery cloth! Cut down high mica below level of commutator so brushes make contact with commutator bars.</p> <p>Inspect squirrel case rotors for broken or loose bars. Check for loose or missing fan blades. Inspect wound rotors and clean thoroughly around collector rings. Refinish pitted, spotted or eccentric rings. Make sure wedges over coils are tight.</p> <p>Make a load test. Compare actual line current with nameplate rating. Use a clamp-on ammeter for this purpose.</p> <p>Clean and blow out windings (or use vacuum cleaner), wipe all dust from motor housing and commutators. Air pressure should be less than 50 pounds. Hand bellows are particularly useful.</p> <p>Inspect starters and branch circuit overcurrent protective devices (fuses, heaters, circuit breakers) to insure proper size ratings.</p> <p>Inspect contacts for wear. Clean and replace if necessary.</p> <p>Check for loose connections, corrosion, freedom of movement of parts, heating, wear, contact pressure, condition of shunts and arc chutes, unusual noises. Correct defective conditions.</p>	<p>4-3-4-3</p> <p>4-2</p> <p>4-4</p> <p>4-3</p> <p>5-4</p> <p>5-4-6-1 5-4-6-2</p> <p>5-4 5-5</p>
Electrician	Annually	<p>Inspect coils to determine if operated at rated voltage.</p> <p>Clean and remove dirt or gum from starters and disconnect device.</p>	<p>5-4-6-4</p> <p>5-4</p>
Electrician	Every 2 years	Test protective devices.	5-4-3 5-4-4